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« Fighting Income Tax Evasion with Positive Rewards: Experimental Evidence »

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Fighting Income Tax Evasion with Positive Rewards: Experimental Evidence

by

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Abstract: This paper provides experimental evidence regarding the influence of positive rewards on income tax evasion behavior. In particular, we experimentally test the impact of positive rewards in form of individual lottery winnings for honest taxpayers. Among other things, we find that these positive rewards lead to a significantly higher rate of tax compliance. Moreover, there are two gender effects. Males not only evade taxes to a much higher extent than females, they also show a stronger positive response to the lottery scheme. This allows us to draw some interesting policy recommendations.

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Fighting Income Tax Evasion with Positive Rewards: Experimental Evidence

1 Introduction

Sun and Wind once had a fierce argument over who would be the more powerful. As they were arguing, they saw a man walking on a secluded road wearing a hat and a coat. It so happened that they agreed to demonstrate their powers to each other by convincing the said man to take off his hat and coat. Immediately the Wind started blowing toward the man. However, once the man realized that the Wind was blowing, he pressed his hat a bit stronger to his head and tightened his coat. So the Wind blew a bit harder. But the harder the Wind blew, the more the man pressed his hat to his head and tightened his grip on the coat. Finally, the Wind had no choice but to concede that he could not convince the man to take off his hat and coat. Then, when the Sun took its turn she smiled to the man and sent her warm rays to him. As the Sun was shining and the man felt the warm rays of the Sun he decided trying to do without his hat. The Sun continued to smile and shine and the man, being happy with wearing no hat, finally decided to take off his coat as well.

The problem of tax evasion is usually approached in a ‘Wind’ fashion, that is, tax evasion is fought with negative sanctions such as fines or even imprisonment for non-honest taxpayers (e.g. see Allingham and Sandmo 1972). However, success of these measures has been rather limited (e.g. see Schneider and Enste 2000; Frey and Jegen 2001; Christie and Holzner 2006; Pickhardt and Sarda 2006). To this extent, the Sun-and-Wind fable motivates the general idea of the present paper: Does the additional option of giving *positive* rewards to honest taxpayers allow for designing a mechanism that eliminates or at least significantly reduces tax evasion? In fact, the purpose of this paper is to develop such a mechanism and to test run it in an experimental setting.

The paper proceeds as follows. The next section provides some background on tax evasion and positive rewards. Section three introduces the experimental design. Section four deals with strategy issues, section five provides experimental results and the final section offers policy recommendations and concludes.

2 Background

Following Gary S. Becker's (1968) work on the economics of crime and Arrow's (1970) work on optimal portfolio analysis under uncertainty, Allingham and Sandmo (1972) developed the first model of rational, utility maximizing taxpayers making their decisions under uncertainty. They conclude that an increase in deterrence parameters, e.g. probability of detection and level of the penalty on undeclared income, will *c. p.* always lead to an increase in actually declared income. Yet, the theoretical analysis of Allingham and Sandmo (1972) has been criticized on the grounds that their findings are not in line with empirical evidence on income tax compliance. For example, based on real values of taxation and deterrence parameters, Alm, McClelland and Schulze (1992, p. 22), argue that individuals pay more taxes than expected utility theory suggests.[1] They conclude that some other factors inevitably influence income tax behavior. Such factors are discussed, for example, as 'appellation of informal penalties' (e.g. see Hasseldine and Kaplan 1992; Violette 1989), and 'positive strategies or appeals to conscience' (e.g. see Slemrod, Blumenthal and Christian 2001; Blumenthal, Christian and Slemrod 2001; Hasseldine and Bebbington 1991). In fact, a large fraction of relevant literature is devoted to the question of why people pay taxes. As a consequence reciprocity, characteristics of the tax exchange, legitimacy and respect between taxpayers and tax authorities, moral or a sense of civic duty are considered as important aspects in tax

[1] Assuming that individuals have a low relative risk aversion, they conclude that less than 14% of actual incomes should be declared. In fact, risk aversion has to be increased to extreme values to end up with more realistic figures of 70% to 90% of income declared.

compliance level explanations (e.g. Feld and Frey 2002, 2003, 2007; Andreoni, Erard and Feinstein 1998). Bazart (2000, 2002) provides a comprehensive overview concerning relevant literature, Torgler (2002) surveys the literature on experiments dealing with tax moral and tax compliance and Slemrod and Yitzhaki (2002) offer a more general overview regarding tax avoidance, tax evasion and tax administration.

Positive incentives for honest taxpayers are a comparatively new issue. In the early nineties, Falkinger and Walther (1991) introduced positive rewards as a complementary measure besides traditional deterrent measures. They show that the combination of the deterrent system (i.e., a penalty on evaded tax) with a pecuniary reward (i.e., a reward per dollar of paid taxes) is welfare improving in comparison with a pure deterrent system as described in Allingham and Sandmo (1972). One can also find early attempts to give a role to positive rewards in some studies focusing on optimal taxation design such as the ones developed by Mookerjee and Png (1989), Cremer and Gahvari (1996), Chandar and Wilde (1998), and Boadway and Sato (2000). The aforementioned theoretical works have been complemented by empirical research. Some studies have focused on the impacts of rewards compared to punishment in cooperation issues (e.g. see Andreoni, Harbaugh, Vesterlund 2003; Halloran and Walker 2004); some focused directly on the tax evasion problem.

Regarding the tax evasion problem, positive rewards were first tested experimentally by Alm, Jackson, McKee (1992), who allowed for different reward schemes. Honest taxpayers could then either participate in a lottery scheme or, alternatively, could receive a fixed lump sum reward. Their conclusion confirmed the efficiency of positive incentives on taxpayers' tax compliance and underlines the efficiency advantage of the lottery scheme in ensuring honest reporting. Moreover, Torgler (2003) provided an experimental test of the relative impact of various factors (fiscal exchange, moral suasion, etc.), including positive rewards, on tax compliance. This field experiment was conducted in Costa Rica with taxpayers having different professions. The highest rate of tax compliance was achieved, in this experiment, under the positive reward scheme. It is worth noting, however, that the analysis of tax compliance regarding the control variable 'gender' did not show any considerable difference between male and female subjects. In contrast, the results presented in section 5 do indicate gender effects.

More recently, Feld and Frey (2007) have described the characteristics of the psychological tax contract existing between taxpayers and tax authorities and emphasized the need for a joint use of negative and positive incentives. Crowding theory (see Frey 1997) already justifies the use of a well designed combination of negative and positive incentives with the heterogeneity of taxpayers' types and motivations.[2] The theory assumes that any external action, positive reward and/or deterrence, can undermine or negatively affect the intrinsic motivation of the taxpayer to pay his taxes if they are perceived to be intrusive. The issue is then to design a mechanism that will be perceived as supportive and that would then raise intrinsic motivation and, as a consequence, lead to more tax compliance.

Thus, in line with the benefit principle of taxation, the tax exchange establishes a link between the taxpayers' contributions and the governmental provision of public goods (see Pickhardt 2006, 2005b). To this extent, the provision of public goods may favor taxpayers' honesty and Alm, Jackson and McKee (1992), as well as Alm, McClelland and Schulze (1992) provide some experimental evidence that supports this view. Yet, although the provision of public goods may be considered as a positive reward for taxpayers, it must be stressed that due to nonrivalness in consumption or the impossibility of applying the price-exclusion principle, non-honest taxpayers may benefit from the provision of public goods in exactly the same way as honest taxpayers do. Therefore, it is worth analyzing the influence of

[2] The heterogeneity of taxpayers' types refers to the fact that the global population is made of honest and dishonest taxpayers. Measures described in the seminal work of Allingham and Sandmo are specifically designed to discourage dishonest taxpayers without considering the sub-population of honest taxpayers. Besides, being audited may have high psychological costs for an honest taxpayer and this is what Motivation Crowding Theory refers to.

positive rewards that accrue exclusively to purely honest taxpayers and in a way that avoids any deviation from honest reporting due to social interaction (e.g. see Becker, Buchner and Sleeking 1987; Spicer and Becker 1980).

In principle, the experimental design which we introduce in the next section follows these routes, but with some modifications.

3 Experimental Design

The next subsection gives a general overview of the design and the following subsection introduces procedure details and links the design to Allingham and Sandmo (1972) as well as to the design of Alm, Jackson and McKee (1992).

3.1 General Aspects

Sessions were conducted in a non-computerized ‘paper and pencil’ fashion at the Chemnitz University of Technology, Germany and at the University of Montpellier, France. A typical session lasted about 90 minutes. Subjects were drawn from first year students of the business administration and economics faculty. There were seven subjects per session, with five subjects participating as ‘acting subjects’, one subject performing the role of the ‘institution’ and another subject performing the role of the ‘public good calculator’. The two roles ‘institution’ and ‘public good calculator’ were performed by subjects with a view to keep the process transparent and credible for the acting subjects.

Each of the five acting subjects received an endowment or income of 100 tokens per round, i.e. $W = 100$, and was told that according to a *generally accepted rule* he or she is supposed to give up 20 of the 100 tokens in each round by submitting these 20 tokens to a third party called ‘institution’. But it was made clear in the instruction sheet that, in principle: (i) each subject may choose any integer from the integer interval [0, 20], (ii) compliance with the ‘give-20-rule’ is randomly audited by the institution and (iii) a penalty applies, if it is found that a subject has not acted according to the rule. In the first block of six rounds all voluntary tax payments to the institution plus enforced payments (reimbursement and penalty) due to an audit are pooled together according to a certain technology and paid back to the subjects as a public good. The second block of six rounds is then characterized by an increase in the detection or auditing rate. However, subjects can freely choose between this higher auditing rate and a lower auditing rate. To encourage opting for the higher auditing rate, there is a positive incentive in form of an individual lottery winning for purely honest taxpayers. Finally, the third block is characterized by an increase in the tax rate on undeclared income (i.e. the penalty rate).

Regarding monetary incentives each subject received a show-up fee of five Euro. In addition, one of the five acting subjects was randomly selected at the end of the session and received one percent of his or her total earnings over the 18 rounds in cash. This total amount ranged from about 20 to almost 30 Euro. The institution and the public good calculator received another five Euro as compensation for not being able to participate in the one percent cash scheme. Monetary incentives were mentioned in the initial instruction sheet and, in addition, explained by the experimenter before the experiment started.

3.2 Procedure

After seating subjects conditions of anonymity were respected in all sessions. In addition, the 'institution' and the 'public good calculator' were always visually separated from the five acting subjects, so that any kind of identification was impossible. Each acting subject received an instructions sheet, an earnings record sheet and a submission form (see appendix). The 'institution' and the 'public good calculator' received the same instructions as the five acting subjects and some additional instructions explaining their specific role and job in the experiment, they also received specific record sheets. All subjects were told to read the instructions sheet quietly. When everybody had finished readings the experimenter summarized the instructions orally and answered questions. The experimenter also asked subjects a few questions to check whether they had fully understood the instructions. Thereafter, the experimenter assigned an ID-Number (1 to 5) to each acting subject. The instruction sheet also informed subjects that three blocks of six rounds each would be played and that they would receive new instructions after each block. Again, at the beginning of each block questions were answered after each subject had finished readings.

First Block: At the beginning of each round subjects choose the amount they wish to contribute to the 'institution' and simultaneously record this amount on their earnings record sheet and the submission form. Subjects are supposed to contribute 20 tokens of their income of 100 tokens, but may in principle choose any integer from the integer interval [0, 20]. Hence, the tax rate, θ, on declared income, X, is $\theta = 0.2$. Yet, for simplicity we have chosen the amount of tax due, θX, as the actual decision variable, rather then X as in Allingham and Sandmo (1972). But as θ is exogenously given and constant, the actual decision variable remains declared income, X, with $\theta X = 20$ implying $X = W$ and $\theta X = 0$ implying $X = 0$.

Subjects place their submission forms face down in front of them, with their ID-Number (1 to 5) written on the back of the form, and the experimenter collects these submission forms. Next, the 'institution' applies its auditing scheme. That is, the subject representing the 'institution' tosses a coin. If the coin shows tales no auditing takes place. However, if the coin shows its face value one card, in the first block, is drawn from a set of cards with numbers 1 to 5, which are taken from the popular UNO card game, and the subject with the corresponding ID-Number is audited. Hence, each subject may be selected for auditing with the probability, $\rho = 1/2 \cdot 1/5 = 0.1$. During an audit the institution learns the true income of the audited subject. If the institution finds that the subject has contributed less than 20 tokens, the tax rate on non-declared income, $\pi = 0.3$, is due. The institution records any amounts due on the relevant submission form and passes all forms on to the 'public good calculator'.

The subject representing the 'public good calculator' then calculates the public good payoff, G, according to equation (1) in the first block:

$$\left(\sum_{i=1}^{n} C_i + R + P\right) \cdot \frac{\lambda}{n} = G \ , \tag{1}$$

where the sum of C_i denotes the voluntarily declared contributions of all five subjects, R refers to the reimbursement of evaded tax, P is the penalty paid by the audited subject if found to be a tax evader, λ can be interpreted as an efficiency parameter and n is the number of acting subjects. The calculation procedure in (1) represents a modified version of the aggregation technology 'average' and coincides with the technology 'summation' for the special case of $n = \lambda$ (see Cornes 1993). The total public good payoff G then accrues simultaneously to all acting subjects according to (2):

$$G = G_1 = G_2 = \ldots = G_n \ , \qquad i = 1, 2, \ldots, n. \tag{2}$$

where G_i refers to the public good payoff received by the i-th subject (see Samuelson 1954; Pickhardt 2006). Once G is calculated, the experimenter announces G by writing G on a board so that all acting subjects can record G on their earnings record sheet. Thereafter, the acting subjects calculate their total earnings of that round. The next round then starts in exactly the same way as the first round with the experimenter distributing a new submission form to each acting subject. After a total of six rounds the first block is completed.

Second Block: In principle, the six rounds of the second block are run in much the same way as in the first block. The major difference is the introduction of a lottery scheme where lottery winnings serve as a positive reward for purely honest tax payers.

In particular, we allow subjects to choose freely between a low value of ρ and a somewhat higher value of ρ. If they wish to choose a low value of ρ they need to join the 'beta-group', and if they wish to choose a somewhat higher value of ρ they need to join the 'alpha-group'. Coins are therefore tossed separately for the two groups. The procedure for the beta-group is exactly the same as in the first block, that is, *one* card is drawn from a stack of UNO cards representing the ID's or the beta-group members. However, if an audit takes place in the alpha-group, *two* cards from a stack of UNO cards representing the alpha-group members are drawn and the submission forms of the corresponding subjects are audited. To motivate subjects to join the alpha-group, their members are entitled to participate in the lottery scheme. In particular, alpha-group subjects that are audited (i.e. either one or two) and are found to be in full compliance with the 'give-20-rule', that is $C_i = \theta X = 20$, are entitled to continue with participating in the lottery scheme. If both audited subjects are entitled to continue, one card is drawn and the subject with the corresponding ID-Number wins a lottery payoff, L, of 72 tokens. Note, however, that according to (3) any lottery winning is deducted from total revenue and, therefore, actual lottery winnings will reduce the amount of the public good, G.

$$\left(\sum_{i=1}^{n} C_i + R + P - L\right) \cdot \frac{\lambda}{n} = G\,, \tag{3}$$

Yet, if there is no audit, there is no lottery and no member of the alpha-group receives the lottery payoff L. This procedure ensures that the lottery payoff, L, is paid to purely honest taxpayers only. Also, it is worth noting that the subjects in both the alpha- and the beta-group are no longer faced with a decision under risk, where the probability of auditing is known, but with a decision under uncertainty as in the real world. This is because the probability of auditing now depends on how many subjects join the alpha- or beta-group, so that with $n = 5$

$= n_a + n_b$, ρ-alpha is: $0.5 \cdot (2/n_a)\ \forall\ n_a \geq 2$ and $0.5 \cdot (1/n_a)$ for $n_a = 1$, and thus can vary from 0.2 to 0.5, whereas ρ-beta is: $0.5 \cdot (1/n_b)\ \forall\ n_b$, and can vary from 0.1 to 0.5.

Third Block: The third block is run in much the same way as in the second block. The only difference with the second block is that the penalty rate is increased from 50 percent of evaded tax to 100 percent of evaded tax, which amounts to a tax rate on undeclared income of $\pi = 0.4$.

Finally, it may be worth noting that apart from differences in parameter values, our design differs in two aspects from that of Alm, Jackson and McKee (1992). First, in our design all subjects receive a fixed and equal income, whereas subject income is variable over a certain range in Alm, Jackson and McKee (1992). Second, in our lottery sessions the probabilities of auditing and lottery winnings are determined endogenously over a certain range, but are fixed in Alm, Jackson and McKee (1992).

4 Strategies

Our theoretical background is in line with Allingham and Sandmo (1972) and Yitzhaki's (1974) extension that introduces a penalty on unpaid taxes in contrast to Allingham and Sandmo's penalty on undeclared income.[3] In particular, we follow Allingham and Sandmo by using their notation and specify a Von-Neumann-Morgenstern utility function of the same kind, but with two differences. First, we use a linear utility function rather than a concave one. Second, following the design described in the preceding section, a public good is provided (see equation (4), third term) that benefits taxpayers and evaders alike. Thus, equation (4) represents the indirect expected utility, *EU*, of the risk neutral representative *i*-th subject in the experiment:

[3] In the experiment we assume a tax rate of $\theta = 0.2$. Now denote by *s* the sanction rate, with *s* = 0.5. Hence, any evader who is audited and detected has to pay: $(\theta W - \theta X_i) + s.(\theta W - \theta X_i) = (\theta + s\theta).(W - X_i)$. Thus, $\pi = (\theta + s\theta) = 0.3$.

$$EU_i = (1-\rho)(W-\theta X_i) + \rho\left[W - \theta X_i - \pi(W - X_i)\right] + \left\{\left(\theta X_i + \theta\sum_{j=1}^{n-1} X_j + \rho\left[\pi(W-X_i) + \pi\sum_{j=1}^{n-1}(W-X_j)\right]\right)\cdot\frac{\lambda}{n}\right\} \qquad (4)$$

where ρ is the probability that the subject or taxpayer is audited by the institution or tax authorities, W is the exogenously given endowment or income which is known by the subject, but not by the institution, θ is the constant tax rate on declared income, X is the income actually declared by the subject and, as noted above, the subject's actual decision variable, π is the constant tax rate on undeclared income, including: (i) reimbursement of evaded taxes (which corresponds to R in (1)), and (ii) penalty on unpaid taxes (which corresponds to P in (1)), and the index j denotes what the other four subjects in the group may contribute to the public good. The first order derivative of (4) is:

$$\frac{\partial EU_i}{\partial X_i} = -\theta(1-\rho) - \rho\theta + \rho\pi + (\theta - \rho\pi)\cdot\frac{\lambda}{n} \qquad (5)$$

Setting (5) equal to zero and rearranging yields:

$$\rho\pi = \theta \ . \qquad (6)$$

If condition (6) holds, any rational, expected utility maximizing subject is indifferent between tax compliance and tax evasion, but for, $\rho\pi > \theta$ (6a), it will fully comply with its taxes and for, $\rho\pi < \theta$ (6b), it will fully evade its taxes. Hence, the linear contribution environment of the experiment allows for corner solutions only. Also, despite the provision of a public good, with the given parameter values, rational, expected utility maximizing subjects will continue to fully evade taxes, because they are trapped in a prisoner's dilemma in which the dominant strategy is not to contribute, that is, declare nothing voluntarily with X_i = 0. Then, with parameter values set at ρ = 0.1, θ = 0.2, π = 0.3, λ = 3, W = 100 and n = 5, it follows from (4) that the expected payoff in the first block is 106 tokens:

$$EU_i = (0.9)\,(100) + 0.1(70) + [(3+12)\cdot 3/5] = 106 \tag{7}$$

where the public good contributions come from expected enforced payments due to audits. In the second and third block, the probability of an audit depends on whether the subject has joined the alpha- or beta-group and on how many other subjects have joined these groups. With n = 5 subjects, six alternative subject allocations are conceivable and the expected payoff per subject and round must be calculated for each allocation and each group separately. Table 1 gives an overview with respect to the conceivable allocations in each of the three blocks.

*** Insert Table 1 about here***

Essentially, the expected payoff of a subject in the alpha-group, EU_a, is calculated according to (8):

$$\begin{aligned} EU_{ai} = {} & \{(1-\rho_a)(W-\theta X_{ai}) + \rho_a[W-\theta X_{ai} - \pi(W-X_{ai})]\} \\ & + \left[\left(\sum_{i=1}^{na}\theta X_{ai} + \varphi\pi(W-X_{ai}) + \sum_{j=1}^{nb}\theta X_{bj} + \varphi\pi(W-X_{bj})\right) - \varphi L\right]\cdot\frac{\lambda}{n} \\ & + \left(\varphi\cdot\frac{2}{n_a}\cdot\varphi\cdot L\right) \end{aligned} \tag{8}$$

where n_a denotes the number of subjects in the alpha-group and φ denotes the probability of either tossing a coin or drawing a card from a stack of two cards, with φ = 0.5. Note, however, that the first term in (8) can be simplified if it is assumed that all subjects in the alpha-group declare their true income, with $W = X_{ai}$. In general, this assumption can be made because any rational, payoff maximizing subject will join the alpha-group only if it is prepared to declare its true income for otherwise the subject cannot win the lottery and would be faced with a higher probability of an audit compared to the beta-group, as two cards rather than just one card are drawn from the alpha stack. Hence, for simplicity, the first term in (8) can be reduced to the certain payoff from declaring the true income. This is shown in (8a):

$$EU_{ai} = (W - \theta X_{ai}) + \left[\left(\sum_{i=1}^{na} \theta X_{ai} + \varphi\pi(W - X_{bj}) \right) - \varphi L \right] \cdot \frac{\lambda}{n} + \left(\varphi \cdot \frac{2}{n_a} \cdot \varphi \cdot L \right) \qquad (8a)$$

with: $W = X_{ai}\ \forall\ i$, $X_{\mathrm{bj}} = 0\ \ \forall\ j$, and $n_a \geq 2$

The second term in (8a) denotes the expected payoff from the public good. Within the squared bracket, the first term denotes the sum of voluntary tax payments from the alpha-group (which will be certain), the second term denotes the expected enforced tax payments (reimbursement and penalty) from the beta-group. The probability of the enforced tax payments is simply that of tossing the coin in the beta-group, because if there is an audit the audited subject will be a tax evader who has declared no income at all, with $X_{\mathrm{bj}} = 0$. In fact, it can be assumed that only tax evaders will join the beta-group because any rational, payoff maximizing subject who is prepared to fully declare its true income will join the alpha-group and, for the given parameter values, any rational, payoff maximizing subject in the beta-group will choose to declare no income at all. Hence, there will be no voluntary tax payments from the beta-group. The third term within the square bracket refers to the lottery payment that will be made with the probability of tossing the coin in the alpha-group, because the lottery wining L will be paid out whenever there is an audit in the alpha-group.

Finally, the third term in (8a) denotes the expected payoff from the lottery, where the first φ denotes the probability of an audit due to tossing the coin, the term $2/n_a$ denotes the probability that the *i*-th subject is drawn if two cards from the alpha stack are drawn, and the second φ denotes the probability that the *i*-th subject's ID is drawn from the stack of two cards representing the ID's of the two audited subjects participating in the lottery. Note, however, that (8a) is defined only for $n_a \geq 2$, because for $n_a = 1$ the second term is reduced to just: $\varphi \cdot L$.

The expected payoff of a subject in the beta-group is calculated according to (9):

$$\begin{aligned} EU_{bi} &= (1-\rho_b)(W-\theta X_{bj}) + \rho_b \left[W - \theta X_{bj} - \pi(W - X_{bj})\right] \\ &\quad + \left[\left(\sum_{i=1}^{na} \theta X_{ai} + \sum_{j=1}^{nb} \theta X_{bj} + \varphi\pi(W - X_{bj})\right) - \varphi L\right] \cdot \frac{\lambda}{n} \end{aligned} \tag{9}$$

where ρ_b denotes the probability of an audit in the beta-group, with: $\varphi \cdot 1/n_b$, which compares to $\rho_a = \varphi \cdot 2/n_a$ for the alpha-group in (8). For $n_b = 5$ equation (9) corresponds to (4).

Now consider Table 1 again. For example, the expected payoff of allocation A0B5, second block, where all five subjects are in the beta-group is exactly the same as in the first block. Also, in allocation A1B4, second block, where one subject is in the alpha-group and the remaining four are in the beta-group, expected net revenue of the government from the alpha-group members is: (1/2 · 20 + 1/2 · (20–72) =) –16 tokens, and from the beta-group: (1/2 · 0 + 1/2 · 30 =) 15 tokens. Thus, overall expected net revenue is –1 token and, therefore, no public good can be provided in allocation A1B4 of the second block (see Table 1).

To analyze optimal behavior patterns under the lottery scheme, we first consider the second block, and suppose again that all subjects are in the beta-group, i.e., allocation A0B5. Each single subject has an incentive to join the alpha-group, if all others stay in the beta-group, because with an expected payoff of 116 tokens (allocation A1B4), the subject joining the alpha-group would be better off. Yet, if all others also join the alpha-group each subject would be even better off with an expected payoff of 125.6 tokens (allocation A5B0, Table 1). Hence, if all subjects are in the beta-group (allocation A0B5), each subject has an incentive to join the alpha-group irrespectively of what the others do. Likewise, irrespectively of what the subject under consideration does, all others have an incentive to join the alpha-group (see Table 1). Moreover, if all subjects have joined the alpha-group no subject has an incentive to deviate and rejoin the beta-group or pursue a 'black sheep' strategy[4], because in both cases the expected payoff would be lower than in allocation A5B0, that is, 120.4 tokens (A4B1) or 124 tokens (A4_1B0) for the 'black sheep' case (see Table 1 and Figure 1). Thus, allocation A5B0 represents a Pareto-optimal Nash-equilibrium, in which every subject *fully* contributes its taxes.

Regarding this full contribution equilibrium the expected net revenue of the government would be 64 tokens per round and the forgone 36 tokens ($\varphi \cdot L$) due to the lottery could be interpreted as information rent which needs to be paid to subjects or taxpayers in exchange for revealing their private information concerning their taxable income. Hence, for the given parameter constellation, any government that expects total income tax evasion in excess of 36 tokens per round (i.e., on average 7.2 tokens per individual), for the given parameter values, could benefit from the introduction of the lottery scheme. Moreover, regarding a full contribution equilibrium it must be stressed that with the given parameter values, condition (6) indicates that a detection rate in excess of ρ = 0.66, or alternatively, a penalty rate in

[4] The term *'black sheep' strategy* refers to an allocation in which a tax evader joins the alpha-group. This allocation is denoted as A4_1B0, which means that there are five subjects in the alpha-group, four honest ones and a non-honest one. This may make sense on the grounds that the probability of detection is lower in the alpha-group than in the beta-group. For example, in allocation A4B1 the probability of detection in the beta-group is ρ = 0.5, but just 0.2 if the subject joins the alpha-group as a 'black sheep'. Payoffs associated with a 'black sheep' strategy are shown in Table 1 in italics. Also, it follows that for tax evaders the probability of auditing, ρ, actually varies only from 0.1 (for B5) to 0.25 (for B2) and is, therefore, not identical with the range of ρ-beta, i.e. 0.1 to 0.5.

excess of 1,000 percent of evaded tax, i.e. $\pi > 2$, would *c.p.* also establish a full contribution equilibrium. But establishing a full contribution equilibrium with just one parameter may not be cost efficient. In fact, the costs associated with $\rho > 0.66$ may be too high, or a penalty of more than 1,000 percent on evaded tax, $\pi > 2$, may be so high that it is not enforceable and, therefore, may not represent a real threat. Moreover, for psychological reasons individuals may react differently to each parameter variation and, therefore, a revenue maximizing combination of the four instruments 'penalty rate', 'detection rate', 'public good' and 'lottery scheme' may exist where each instrument plays its role by assuming a non-zero value.

In the third block, as noted, the penalty rate on evaded tax is raised from 50 percent to 100 percent, and the tax rate on undeclared income is, therefore, $\pi = 0.4$. As shown in Table 1, the higher penalty rate increases the incentive of each single subject to join the alpha-group, but only at the margin. This is because the negative effect of the higher penalty on the expected payoff from full tax evasion is compensated to some extent by a higher public good payoff (see Table 1). This effect results from incorporating the revenue of the penalty into the calculation procedure for the public good payoff according to (3). Hence, removing P from (3) would help a government to establish a full contribution equilibrium and, because no penalty would be paid once such equilibrium is established, no welfare loss would result from removing P from (3). In any case, it must be emphasized that the penalty increase does give an economic incentive to change the behavior pattern in the third block in comparison to that of the second block.

To summarize, with parameter values specified as described above, rational and utility maximizing individuals would fully evade their taxes in the first block. In contrast, rational and utility maximizing individuals would have an incentive to fully pay their taxes in both the second and third block. This is because of the introduction of individual lottery winnings for purely honest taxpayers and because a public good is provided. More precisely, if a subject deviates from honestly declaring its true income, the increase in expected individual base payoff does not compensate the decrease in expected lottery winnings and the expected individual public good payoff. For example, consider Table 2, second block, allocation A5B0 versus A4B1. With respect to the deviating subject, the increase in expected base payoff from 80 to 85 tokens does not compensate the drop in expected lottery payoff from 7.2 to 0 tokens plus the drop in expected public good payoff from 38.4 to 35.4, as the net change in total expected payoff is -5.2 tokens.

5 Results

Results of a total of nine sessions are presented in Table 2. Five of these nine sessions were conducted in Chemnitz/Germany (C1 to C5) and four in Montpellier/France (M1 to M4). All results in Table 2 are denoted in tokens, except '*M/F*' which denotes the number of males and females, respectively, '*checked*' which denotes the number of audited subjects and '*TC-Ratio*' which refers to the percentage share of full compliances (i.e., the nominator shows how often subjects have given 20 tokens). '*Declared*' refers to the sum of all voluntary contributions, $\sum C_i = \sum \theta X_i$, actually made by the five acting subjects in the relevant block of six rounds, '*Enforced*' are taxes or reimbursements paid due to an audit, '*P*' are penalties paid due to non-compliance, '*Net Rev.*' refers to total net revenue collected by the government (that is, declared + enforced + P) with figures in parenthesis denoting expected net revenue and '*Payoff*' denotes the aggregate payoff of all subjects in a block of six rounds.

Insert Table 2 about here

A Wilcoxon-Mann-Whitney rank-sum test on the items 'Declared', 'TC-Ratio', Net Revenue' and 'Payoff' shows that in most cases we cannot reject the null hypothesis that the figures are drawn from the same population. Exceptions are 'Declared', third block, where we can reject the null hypothesis at the ten percent level, 'TC-Ratio', first and third block, where the null hypothesis is rejected at the ten percent and five percent level, respectively, and ‘Net Revenue’, third block, where the null is rejected at the ten percent level. However, if the relevant differences between blocks are considered for each of these four items, in all cases we cannot reject the null hypothesis that the figures are drawn from the same population. Hence, although there might be some differences regarding the impact of the penalty and with respect to full compliance behavior, we conclude that in general there is no significant difference between subject behavior in Chemnitz and Montpellier, so that we can analyze all nine sessions jointly.

First Block

With respect to the first block it follows from Table 2, ‘Declared’, that the actual voluntary contribution level or tax compliance level is substantially higher than that calculated for rational, expected utility maximizing subjects in the preceding section, i.e., zero.[5] However, the ‘TC-Ratio’ shows that the level of full compliance is substantially lower. Further, the actual number of audits, i.e. 24, is sufficiently close to the expected value of 27. In other words, audits have generated additional revenue and, therefore, net revenue exceeds voluntary contributions (‘Declared’) in each case. Note, however, that in contrast to ‘Declared’, which may vary from 0 to 600 tokens, ‘Net Revenue’ may in principle vary from 0 to 660 tokens, where 660 tokens implies that there is always just one tax evader and this tax evader is always audited.

Second and third block

First of all, it is worth noting that in none of the sessions the theoretically expected full contribution environment (i.e. ‘Declared’ = 600) has emerged, except for session M4, third

[5] Yet, the contribution levels are by and large in line with results from public goods games in the laboratory or classroom (e.g. see Ledyard 1995 and Pickhardt 2005a), where subjects contribute 40 to 60 percent of their endowment voluntarily.

block. This notwithstanding, a comparison of the ‘Declared’ figures in the second and third block with those in the first block demonstrates that the lottery scheme has a strong and positive influence on tax compliance (see Table 2). A Wilcoxon signed ranks test (see Table 3) shows that we can reject the null hypothesis of no difference in ‘Declared’ after implementation of the lottery scheme for both the Chemnitz and Montpellier subset at the ten percent level and for the joint set at least at the five percent level. In particular, we can conclude that voluntary contributions made in both the second and the third blocks are significantly higher (one percent level) than in the first block. In addition, they are also significantly higher (five percent level) in the third block than in the second block.

Essentially the same result holds true if we compare the TC-Ratios. Inspection of Table 3 reveals that test results for the TC-Ratio, joint set, allow rejection of the null hypothesis in all cases at the one percent level. In comparison with the ‘Declared’ figures this indicates that the lottery scheme not only yields a higher level of tax compliance, but that this increase is predominantly achieved by a much higher rate of full compliance. This further indicates that our scheme of rewarding only purely honest taxpayers does work with respect to tax compliance.

However, although in some cases we do observe that our scheme yields higher net revenues and/or a higher payoff in either the second or third block (see Table 2), these results are statically not significant. In fact, in both cases we cannot reject the null hypothesis of no difference (for brevity test statistics are not displayed). Therefore, we conclude that the scheme neither increases net revenue for the government nor payoff for the subjects. Yet, at this point it must be emphasized that in sessions C5, M1 and M4 the net revenue of the first block already exceeds the expected revenue of 384 tokens in the second and third block. Therefore, in these sessions the scheme could not have worked because the level of initial tax compliance was too high. Likewise, in sessions C1, C3, and M2 net revenue of the first block is fairly close to the expected revenue level and, thus, even under extremely favorable circumstances the scheme could have worked only at the margin. In the remaining three sessions C2, C4 and M3 the scheme has worked with respected to net revenue and/or payoff, except where extremely unfavorable odds have prevented that (i.e. session C2, third block). To put it differently, the scheme has neither significantly increased net revenue for the government nor payoff for the subjects because the initial rate of tax compliance was too high in most of the sessions.

Gender

To test for possible gender effects we first did a Wilcoxon-Mann-Whitney test on the individual 'Declared' results of all 45 subjects (not displayed here). Regarding the 16 male subjects, we find a *p*-value of 0.34 (see Siegel and Castellan 1985**,** Table J, for W_x = 64, m = 7, n = 9) and, thus, cannot reject the null hypothesis that they are drawn from the same population. Likewise, with respect to the 29 female subjects, we find a *p*-value of 0.28 (see Siegel and Castellan 1985, Table A, for W_x = 208, m = 13, n = 16). Hence, we can conclude that both males and females show the same behavior pattern in Chemnitz and in Montpellier and that we can, therefore, analyze them jointly. However, regarding males versus females, we find a *p*-value of 0.0008 (see Siegel and Castellan 1985, Table A, for W_x = 234.5, m = 16, n = 29). Thus, we can reject the null hypothesis at the one percent level and conclude that males and females do not show the same behavior pattern. Put differently, regarding a subject's voluntary tax compliance behavior it does not matter whether the subject is French or German, but it does matter whether the subject is male or female. In this context, it is worth noting that Alm and Torgler (2006), based on data from the World Values Survey, do find some differences in tax morale between taxpayers in France and Germany. However, the difference between France and Germany seems to be much smaller than differences between other European countries or between European countries and the USA (see Alm and Torgler, 2006, p. 239).

Moreover, gender specific results presented in Table 4 and results from a Wilcoxon signed ranks test in Table 5 show that the lottery scheme has a positive impact on tax compliance for both female and male taxpayers. In particular, for the joint set we can reject the null hypothesis of no differences in each case at the one percent level and conclude that the lottery scheme has increased tax compliance for both males and females. The only exception is the difference between the third and second block. Regarding males we cannot reject the null hypothesis of no difference, but with respect to females we can reject the null hypothesis at the five percent level. Therefore, we conclude that the penalty increase had no impact on male behavior, but did influence the behavior of females to some extent. This supports the view expressed earlier on (see section 4) that individuals may react differently to instruments used for fighting tax evasion.

Furthermore, results presented in Table 4, first block, support the finding of Spicer and Becker (1980, p. 174) that *c.p.* “males evade a greater percentage of their taxes than females” (see also Baldry 1987 for similar results). In fact, in the first block males contributed on average only 44 tokens per block, whereas females contributed on average 80 tokens per block. Also, inspection of the TC-Ratios shows that females more often show a full compliance behavior than males do. In both case, essentially the same is true for both the Chemnitz and Montpellier subset.

In addition, positive rewards in form of the lottery scheme had a much stronger impact on males than on females. Inspection of Table 4 shows that males have increased their average voluntary contribution from 44 tokens in the first block to 84 tokens in the second block and, thus, by factor 1.9. In contrast, females have increased their average voluntary contribution from 80 tokens in the first block to 96 tokens in the second block and, thus, just by factor 1.2. Comparing the third and the first block yields a similar result and also shows that males in France and in Germany have increased their voluntary contributions by almost the same factor of 2.2. This is also true for females, but at a lower rate of about 1.35. It is also worth noting that the gap between voluntary male and female contributions is substantially smaller in the third block as compared to the one described above for the first block (see Table 4). To this extent, the lottery scheme has generated a more uniform tax compliance behavior.

Finally, it should be stressed that in general the results support the findings of Alm, Jackson and McKee (1992) with respect to the influence of positive rewards on honest taxpayers.

6 Policy Recommendations and Concluding Remarks

In this paper we have tested a new experimental design for analyzing the impact of positive rewards on individual tax compliance. Important features of the design are that it applies for purely honest taxpayers only and that the probability of an audit is endogenously determined. To this extent, the design is close to a real world environment. Evidence from various sessions suggests that positive rewards in form of individual lottery winnings for purely honest taxpayers have a strong positive impact on tax compliance, as they pull potential tax evaders into the honest taxpayer domain. In addition, our results suggest that this positive impact on tax compliance is particularly strong for male taxpayers. Further, our results confirm the findings of others that male taxpayers evade a greater percentage of their taxes than females. Yet, it has been demonstrated in section four that the lottery scheme implies some costs (i.e. an information rent) and can, therefore, be revenue enhancing for the government only if the actual net revenue before the introduction of the lottery scheme is below a certain threshold (i.e., 384 tokens, see Table 2). The results presented in section five support this view.

Taken together, our findings imply that the introduction of individual lottery winnings for purely honest taxpayers will be rather successful in terms of an overall revenue increase in economies with a low rate of tax compliance and a high share of male taxpayers. As such circumstances may predominantly prevail in developing countries, introducing individual lottery winnings for honest taxpayers might be a promising tax policy option for developing countries. In any case, results shown in this paper and in previous literature on positive rewards for honest taxpayers suggests that more research in this direction, including field experiments, should be done.

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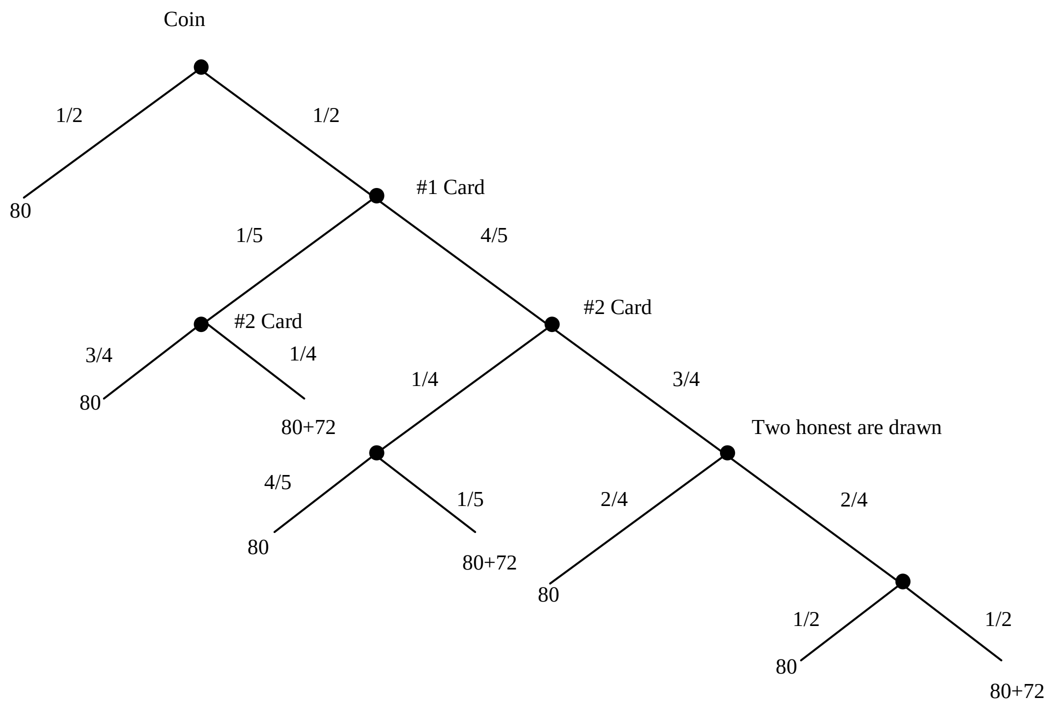
Figure 1: Probability and Payoff Calculation 'Black Sheep' Strategy, #2 Block

Probability A4_1



Expected Payoff (Base and Lottery) for Each of the Four Honest Taxpayers (A4_1)

$$\frac{1}{2}\cdot 80+\frac{1}{2}\cdot\frac{1}{5}\cdot\frac{3}{4}\cdot 80+\frac{1}{2}\cdot\frac{1}{5}\cdot\frac{1}{4}\cdot 152+\frac{1}{2}\cdot\frac{4}{5}\cdot\frac{1}{4}\cdot\frac{4}{5}\cdot 80+\frac{1}{2}\cdot\frac{4}{5}\cdot\frac{1}{4}\cdot\frac{1}{5}\cdot 152+\frac{1}{2}\cdot\frac{4}{5}\cdot\frac{3}{4}\cdot\frac{2}{4}\cdot 80$$
$$+\frac{1}{2}\cdot\frac{4}{5}\cdot\frac{3}{4}\cdot\frac{2}{4}\cdot\frac{1}{2}\cdot 80+\frac{1}{2}\cdot\frac{4}{5}\cdot\frac{3}{4}\cdot\frac{2}{4}\cdot\frac{1}{2}\cdot 152=0.88\cdot 80+0.12\cdot 152=88.64$$

Expected Payoff for the 'Black Sheep' (A4_1)

$$\frac{1}{2}\cdot 100+\frac{1}{2}\cdot\frac{1}{5}\cdot 70+\frac{1}{2}\cdot\frac{4}{5}\cdot\frac{1}{4}\cdot 70+\frac{1}{2}\cdot\frac{4}{5}\cdot\frac{3}{4}\cdot\frac{4}{5}\cdot 100=0.8\cdot 100+0.2\cdot 70=94$$

Expected Public Good Payoff

$$\left[\frac{1}{2}\cdot 80+\frac{1}{2}\cdot\frac{4}{5}\cdot\frac{3}{4}\cdot(80-72)+\frac{1}{2}\cdot\frac{1}{5}\cdot 1\cdot(80+30-72)+\frac{1}{2}\cdot\frac{4}{5}\cdot\frac{1}{4}\cdot(80+30-72)\right]\cdot\frac{3}{5}=30$$

Table 1: Expected Individual Payoffs per Round and Block (in tokens)

#1 Block

All Subjects		
Base	*PG*	*EP*
97	9	106

#2 Block

Alpha-Group					*Beta-Group*			
No.	*Base*	*PG*	*L*	*EP*	*No.*	*Base*	*PG*	*EP*
A0	-	-	-	-	B5	97	9	106
A1	80	0	36	116	B4	96.25	0	96.25
A2	80	11.4	18	109.4	B3	95	11.4	106.4
A3	80	23.4	12	115.4	B2	92.5	23.4	115.9
A4	80	35.4	9	124.4	B1	85	35.4	120.4
A4_1	*80*	*30*	*8.64*	*118.64*	*A_1*	*94*	*30*	*124*
A5	80	38.4	7.2	125.6	B0	-	-	-

#3 Block

Alpha-Group					*Beta-Group*			
No.	*Base*	*PG*	*L*	*EP*	*No.*	*Base*	*PG*	*EP*
A0	-	-	-	-	B5	96	12	108
A1	80	2.4	36	118.4	B4	95	2.4	97.4
A2	80	14.4	18	112.4	B3	93.3	14.4	107.7
A3	80	26.4	12	118.4	B2	90	26.4	116.4
A4	80	38.4	9	127.4	B1	80	38.4	118.4
A4_1	*80*	*31.2*	*8.64*	*119.84*	*A_1*	*92*	*31.2*	*123.2*
A5	80	38.4	7.2	125.6	B0	-	-	-

Note: Base denotes the expected payoff base value, PG denotes the expected payoff from public good provision, L denotes the expected payoff from the lottery and EP denotes the total expected payoff per subject in tokens, i.e., Base + PG [+L]. No. denotes the allocation with A and B referring to the alpha- and beta-group, respectively, and the attached number denotes the number of subjects in either the alpha- or beta-group. A4_1 denotes the expected payoff of the four honest subjects when a 'black sheep' strategy is pursued with five subjects in the alpha-group, of which only four are honest and one is a tax evader (the 'black sheep'). A_1 denotes the expected payoff of the 'black sheep'.

Table 2: Results per Block and Session for Chemnitz and Montpellier (in tokens)

	Chemnitz					Montpellier				Average		
	C1	C2	C3	C4	C5	M1	M2	M3	M4	CA	MA	TA
(M/F)	(2/3)	(2/3)	(2/3)	(3/2)	(0/5)	(2/3)	(1/4)	(3/2)	(1/4)	(9/16)	(7/13)	(16/29)
#1 Block												
Declared	349	241	337	252	458	396	295	277	424	327	348	337
TC-Ratio	0/30	4/30	3/30	1/30	4/30	11/30	7/30	1/30	15/30	2/30	9/30	5/30
Enforced	18	20	19	60	10	39	54	21	20	26	34	30
(Checked)	(2)	(2)	(2)	(4)	(2)	(4)	(4)	(2)	(2)			
P (50%)	9	10	9.5	30	5	19.5	27	10.5	10	13	17	15
Net Rev.	*376*	*271*	*365.5*	*342*	*473*	*455*	*376*	*308.5*	*454*	*366*	*398*	*382*
	(90)	*(90)*	*(90)*	*(90)*	*(90)*	*(90)*	*(90)*	*(90)*	*(90)*	*(90)*	*(90)*	*(90)*
Payoff	*3706*	*3542*	*3729*	*3580*	*3941*	*3949*	*3682*	*3617*	*3940*	*3700*	*3797*	*3743*
#2 Block												
Declared	410	532	495	420	374	440	469	404	587	446	475	461
TC-Ratio	10/30	25/30	23/30	15/30	16/30	22/30	21/30	19/30	28/30	18/30	23/30	20/30
Enforced	44	3	0	20	60	0	20	40	0	25	15	20
(Checked)	(α=5; β=5)	(α=4; β=1)	(α=6; β=2)	(α=4; β=1)	(α=5; β=3)	(α=2; β=1)	(α=2; β=2)	(α=6; β=2)	(α=4; β=1)			
P (50%)	22	1.5	0	10	30	0	10	20	0	13	8	10
(-)Lottery	72	144	216	144	216	72	144	216	144	187	144	166
Net Rev.	*404*	*392.5*	*279*	*306*	*248*	*368*	*354*	*248*	*443*	*297*	*353*	*325*
	(384)	*(384)*	*(384)*	*(384)*	*(384)*	*(384)*	*(384)*	*(384)*	*(384)*	*(384)*	*(384)*	*(384)*
Payoff	*3535*	*3791*	*3629*	*3611*	*3518*	*3706*	*3758*	*3586*	*3884*	*3617*	*3734*	*3669*
#3 Block												
Declared	491	482	500	476	528	505	492	580	600	495	544	519
TC-Ratio	20/30	23/30	24/30	19/30	22/30	24/30	24/30	29/30	30/30	19/30	27/30	24/30
Enforced	41	0	0	46	1	50	18	0	0	18	7	13
(Checked)	(α=4; β=3)	(α=12 ; β=1)	(α=8; β=0)	(α=7; β=4)	(α=6; β=1)	(α=8; β=2)	(α=6; β=1)	(α=4; β=0)	(α=4; β=0)			
P (100%)	41	0	0	46	1	50	18	0	0	18	7	13
(-)Lottery	144	432	288	288	216	288	216	144	144	274	198	236
Net Rev.	*429*	*50*	*212*	*280*	*314*	*317*	*312*	*436*	*456*	*257*	*360*	*309*
	(384)	*(384)*	*(384)*	*(384)*	*(384)*	*(384)*	*(384)*	*(384)*	*(384)*	*(384)*	*(384)*	*(384)*
Payoff	*3878*	*3096*	*3430*	*3608*	*3628*	*3624*	*3624*	*3872*	*3912*	3528	3758	3630

Note: 'M/F' refers to the number of male/female subjects, 'Declared' denotes total voluntary contributions (max. 600), 'TC-Ratio' denotes total compliance ratio, which is measured as the number of full compliances (frequency of 20) over the total number of tax payments per block (i.e. 5·6=30), 'Enforced' denotes reimbursements enforced due to an audit, 'Checked' denotes the number of checked or audited subjects, 'P' denotes penalty payments due to an audit, 'Lottery' denotes lottery winnings, and 'Net Rev.' denotes the net income of the government (declared+enforced+penalty[-lottery]) and figures in parentheses denote expected net revenue per block according to section four (for example, first block all sessions, 90 is calculated from: 100-97=3, 3·5·6=90), 'Payoff' denotes total payoff per block.

Table 3: Wilcoxon Signed Ranks Test on Declared and TC-Ratio

Session	**C1**	**C2**	**C3**	**C4**	**C5**	*M1*	*M2*	*M3*	*M4*	**PRS**	**p-value**
Declared											
(#2 - #1)	61	291	158	168	-84	*44*	*174*	*127*	*163*	C *M*	
Rank	1	5	3	4	(2)	*1*	*4*	*2*	*3*	13 *10*	*0.0938 / 0.0625*
Rank	2	9	5	7	(3)	*1*	*8*	*4*	*6*	42	0.0098
(#3 - #2)	81	-50	5	56	154	*65*	*23*	*176*	*13*	C *M*	
Rank	4	(2)	1	3	5	*3*	*2*	*4*	*1*	13 *10*	*0.0938 / 0.0625*
Rank	7	(4)	1	5	8	*6*	*3*	*9*	*2*	41	0.0137
(#3 - #1)	142	241	163	224	70	*109*	*197*	*303*	*176*	C *M*	
Rank	2	5	3	4	1	*1*	*3*	*4*	*2*	15 *10*	*0.0313 / 0.0625*
Rank	3	8	4	7	1	*2*	*6*	*9*	*5*	45	0.0020
TC-Ratio											
(#2 - #1)	10	21	20	14	12	*11*	*14*	*18*	*13*	C *M*	
Rank	1	5	4	3	2	*1*	*3*	*4*	*2*	15 10	*0.0313 / 0.0625*
Rank	1	9	8	5.5	3	*2*	*5.5*	*7*	*4*	45	0.0020
(#3 - #2)	10	-2	1	4	6	*2*	*3*	*10*	*2*	C *M*	
Rank	5	(2)	1	3	4	*1.5*	*3*	*4*	*1.5*	13 10	*0.0938 / 0.0625*
Rank	8.5	(3)	1	6	7	*3*	*5*	*8.5*	*3*	42	0.0098
(#3 - #1)	20	19	21	18	18	*13*	*17*	*28*	*15*	C *M*	
Rank	4	3	5	1.5	1.5	*1*	*3*	*4*	*2*	15 10	*0.0313 / 0.0625*
Rank	7	6	8	4.5	4.5	*1*	*3*	*9*	*2*	45	0.0020

Note: #2-#1, #3-#2, and #3-#1 denote the difference of the relevant values in the two blocks under consideration, parenthesis denote negative ranks, PRS denotes the sum of the positive ranks and p-values are taken from Siegel and Castellan (1985, p. 332). With respect to the TC-Ratio differences are based on the nominators (see Table 2) only as the denominators are identical in each case.

Table 4: Gender Specific Results per Block and Session for Chemnitz and Montpellier

	Chemnitz					Montpellier				Average		
	C1	**C2**	**C3**	**C4**	**C5**	**M1**	**M2**	**M3**	**M4**	**CA**	**MA**	**TA**
(M/F)	(2/3)	(2/3)	(2/3)	(3/2)	(-/5)	(2/3)	(1/4)	(3/2)	(1/4)	(9/16)	(7/13)	(16/29)
#1 Block Males	2	2	2	3	-	2	1	3	1	9	7	16
Declared	67	15	59	29	-	50	33	64	20	41	49	44
TC-Ratio	0/12	0/12	1/12	1/18	-	0/12	0/6	1/18	1/6	-	-	-
Enforced	8	10	14	60	-	24	10	1	20	-	-	-
P (50%)	4	5	7	30	-	12	5	0.5	10	-	-	-
Net Rev.	*145*	*45*	*139*	*176*	-	*135*	*48*	*192.5*	*50*	*56*	*61*	*58*
Payoff	*1,491*	*1,480*	*1,504*	*2,245*	-	*1,620*	*772*	*2,163*	*822*	*747*	*768*	*756*
#1 Block Females	3	3	3	2	5	3	4	2	4	16	13	29
Declared	72	70	73	83	92	99	66	43	101	79	81	80
TC-Ratio	0/18	4/18	2/18	0/12	4/30	11/18	7/24	0/12	14/24	-	-	-
Enforced	10	10	5	0	10	15	44	20	0	-	-	-
P (50%)	5	5	2.5	0	5	7.5	22	10	0	-	-	-
Net Rev.	*231*	*226*	*227*	*166*	*473*	*320*	*328*	*116*	*404*	*83*	*90*	*86*
Payoff	*2,220*	*2,062*	*2,225*	*1,445*	*3,941*	*2,299*	*2,910*	*1,454*	*3,118*	*743*	*752*	*747*
#2 Block Males	2	2	2	3	-	2	1	3	1	9	7	16
Declared	82	120	95	70	-	40	90	85	120	89	78	84
TC-Ratio	5/12	12/12	9/12	10/18	-	4/12	3/6	12/18	6/6	-	-	-
Enforced	8	0	0	20	-	0	10	20	0	-	-	-
P (100%)	4	0	0	10	-	0	5	10	0	-	-	-
(-)Lottery	-	-	-	144	-	-	-	144	72	-	-	-
Net Rev.	*175*	*240*	*190*	*96*	-	*80*	*105*	*140*	*48*	*78*	*53*	*67*
Payoff	*1,487*	*1,431*	*1,367*	*2,250*	-	*1,550*	*718*	*2,160*	*816*	726	749	736
#2 Block Females	3	3	3	2	5	3	4	2	4	16	13	29
Declared	82	97	102	105	75	120	95	75	117	89	104	96
TC-Ratio	5/18	13/18	14/18	5/12	16/30	18/18	18/24	7/12	22/24	-	-	-
Enforced	36	3	0	0	60	0	10	20	0	-	-	-
P (100%)	18	1.5	0	0	30	0	5	10	0	-	-	-
(-)Lottery	72	144	216	-	216	72	144	72	72	-	-	-
Net Rev.	*229*	*153*	*89*	*210*	*248*	*288*	*364*	*108*	*395*	*58*	*89*	*72*
Payoff	*2,048*	*2,360*	*2,262*	*1,361*	*3,518*	*2,156*	*3,040*	*1,426*	*3,068*	*722*	*745*	*732*
#3 Block Males	2	2	2	3	-	2	1	3	1	9	7	16
Declared	86	105	80	83	-	80	120	113	120	88	106	96
TC-Ratio	6/12	10/12	8/12	11/18	-	8/12	6/6	17/18	6/6	-	-	-
Enforced	15	0	0	40	-	40	0	0	0	-	-	-
P (100%)	15	0	0	40	-	40	0	0	0	-	-	-

(-)Lottery	-	216	144	72	-	72	-	144	-	-	-	-
Net Rev.	*201*	*-6*	*16*	*258*	-	*168*	*120*	*196*	*120*	*52*	*86*	*67*
Payoff	*1,504*	*1266*	*1441*	*2075*	-	*1,412*	*667*	*2,389*	*754*	*698*	*746*	*719*
#3 Block												
Females	3	3	3	2	5	3	4	2	4	16	13	29
Declared	107	91	113	113	106	115	93	120	120	106	111	108
TC-Ratio	14/18	13/18	16/18	8/12	22/30	16/18	18/24	12/12	24/24	-	-	-
Enforced	26	0	0	6	1	10	18	0	0	-	-	-
P (100%)	26	0	0	6	1	10	18	0	0	-	-	-
(-)Lottery	144	216	144	216	216	216	216	-	144	-	-	-
Net Rev.	*230*	*56*	*196*	*10*	*314*	*149*	*192*	*240*	*336*	*50*	*69*	*59*
Payoff	*2,324*	*1,830*	*1,989*	*1,533*	*3,628*	*2,212*	*2,957*	*1,483*	*3,158*	*707*	*755*	*728*

Note: ‘M/F’ refers to the number of male and female subjects, ‘Declared’ denotes voluntary contributions per capita and block of 6 rounds for either males or females, multiplying these figures with the number of males and females, respectively, and adding the values for males and females gives the corresponding values in Table 2, ‘TC-Ratio’ denotes total compliance ratio, which is measured as the number of full compliances (i.e., 20 tokens given) over the total number of tax payments per block for males and females, ‘Enforced’ denotes reimbursements enforced due to an audit, ‘Penalty’ denotes penalty payments due to an audit, ‘Lottery’ denotes lottery winnings, and ‘Net Rev.’ denotes the net income of the government per block from either males or females, adding up of the male and female figures gives the corresponding value in Table 2,‘Payoff’ denotes payoff per block for males and females, again adding up yields relevant figures in Table 2.

Table 5: Wilcoxon Signed Ranks Test on Declared and TC-Ratio for Males and Females

Session	C1	C2	C3	C4	C5	*M1*	*M2*	*M3*	*M4*	**PRS**	***p-value***
Males/Declared											
(#2 - #1)	15	105	36	41	-	*-10*	*57*	*21*	*100*	C M	
Rank	1	4	2	3	-	*(1)*	*3*	*2*	*4*	*10 9*	*0.0625/0.125*
Rank	2	8	4	5	-	*(1)*	*6*	*3*	*7*	*35*	*0.0078*
(#3 - #2)	4	-15	-15	13	-	*40*	*30*	*28*	*0*	C M	
Rank	1	(3.5)	(3.5)	2	-	*3*	*2*	*1*	-	*3 6*	*>0.5/0.125*
Rank	1	(3.5)	(3.5)	2	-	*7*	*6*	*5*	-	*21*	*0.1484*
(#3 - #1)	19	90	21	54	-	*30*	*87*	*49*	*100*	C M	
Rank	1	4	2	3	-	*1*	*3*	*2*	*4*	*10 10*	*0.0625/0.0625*
Rank	1	7	2	5	-	*3*	*6*	*4*	*8*	*36*	*0.0039*
Females/Declared											
(#2 - #1)	10	27	29	22	-17	*21*	*29*	*32*	*16*	C M	
Rank	1	4	5	3	(2)	*2*	*3*	*4*	*1*	*13 10*	*0.0938/0.0625*
Rank	1	6	7.5	5	(3)	*4*	*7.5*	*9*	*2*	*42*	*0.0098*
(#3 - #2)	25	-6	11	8	31	*-5*	*-2*	*55*	*3*	C M	
Rank	4	(1)	3	2	5	*(3)*	*(1)*	*4*	*2*	*14 6*	*0.0625/0.4375*
Rank	7	(4)	6	5	8	*(3)*	*(1)*	*9*	*2*	*37*	*0.0488*
(#3 - #1)	35	21	40	30	14	*16*	*27*	*77*	*19*	C M	
Rank	4	2	5	3	1	*1*	*3*	*4*	*2*	*15 10*	*0.0313/0.0625*
Rank	7	4	8	6	1	*2*	*5*	*9*	*3*	*45*	*0.0020*
Males/TC-Ratio											
(#2 - #1)	0.42	1	0.67	0.5	-	*0.33*	*0.5*	*0.61*	*0.83*	C M	
Rank	1	4	3	2	-	*1*	*2*	*3*	*4*	10 10	*0.0625/0.0625*
Rank	2	8	6	3.5	-	*1*	*3.5*	*5*	*7*	*36*	*0.0039*
(#3 - #2)	0.08	-0.2	-0.1	0.05	-	*0.33*	*0.5*	*0.28*	*0*	C M	
Rank	2.5	(4)	(2.5)	1	-	*2*	*3*	*1*	-	*3.5 6*	*>0.5/0.125*
Rank	2.5	(4)	(2.5)	1	-	*6*	*7*	*5*	-	*21.5*	*0.1484*
(#3 - #1)	0.5	0.83	0.58	0.55	-	*0.67*	*1*	*0.89*	*0.83*	C M	
Rank	1	4	3	2	-	*1*	*4*	*3*	*2*	*10 10*	*0.0625/0.0625*
Rank	1	5.5	3	2	-	*4*	*8*	*7*	*5.5*	*36*	*0.0039*
Females/TC-Ratio											
(#2 - #1)	0.28	0.5	0.67	0.42	0.4	*0.39*	*0.46*	*0.58*	*0.33*	C M	
Rank	1	4	5	3	2	*2*	*3*	*4*	*1*	*15 10*	*0.0313/0.0625*
Rank	1	7	9	5	4	*3*	*6*	*8*	*2*	*45*	*0.0020*
(#3 - #2)	0.5	0	0.11	0.25	0.2	*-0.1*	*0*	*0.42*	*0.08*	C M	
Rank	4	-	1	3	2	*(2)*	-	*3*	*1*	*10 4*	*0.0625/>0.5*
Rank	7	-	2.5	5	4	*(2.5)*	-	*6*	*1*	*25.5*	*0.0391*
(#3 - #1)	0.78	0.5	0.78	0.67	0.6	*0.28*	*0.46*	*1*	*0.42*	C M	
Rank	4.5	1	4.5	3	2	*1*	*3*	*4*	*2*	*15 10*	*0.0313/0.0625*
Rank	7.5	4	7.5	6	5	*1*	*3*	*9*	*2*	*45*	*0.0020*

Note:#2-#1, #3-#2, and #3-#1 denote the difference of the relevant values in the two blocks under consideration, parenthesis denote negative ranks, PRS denotes the sum of the positive ranks and p-values are taken from Siegel and Castellan (1985, p. 332). With respect to the TC-Ratio *differences are here based on the actual ratio (see Table 2) because the number of males and females varies.*

Appendix

French and German translations of the following instructions were used for the experiment.

Instructions

In this experiment you are an agent in a model economy. You will receive in each round 100 units of a good (column B in your earnings record sheet). A generally accepted ruling says that you are required to give 20 units to an institution which is part of the model economy (column C). However, in principle, each agent can freely choose the amount which he or she gives to the institution from the integer interval [0, 20], with: {0, 1, 2, …, 18, 19, 20}.

Yet, the institution will monitor compliance with the ruling at random. In case that a random check reveals that less then 20 units have been given, the difference and a penalty is due. The penalty is half of the difference that is due. *Example: Required 20; actually given 16; Difference due 4; penalty due 2; total 22.*

Monitoring Modus:
After each round the institution decides by tossing a coin whether or not a check will be carried out or not. If the coin shows its face value (number) the check will be carried out, otherwise there is no check.

If a check is carried out, *one* card will be drawn from a properly mixed stack of cards with the numbers 1 to 5. The agent associated with the number drawn will be checked. All other agents will not be checked. The check will be in private and the results will not be made public.

Payoff
The 'calculator' will summarize all individual contributions, including differences and penalties due. The sum will be divided by the number of players. This result will be tripled. The resulting amount will be paid to each agent and put into column (F) on your earnings record sheet.

Your Job
It is your job to maximize your total earnings (column G) over all rounds of the block.

We will play 6 rounds one after the other. Thereafter you will receive new instructions and we play another block of 6 rounds. Thereafter, you receive new instructions and a third block of 6 rounds will be played. Thereafter the experiment ends.

After the experiment one agent will be determined at random by drawing a card as described above. This agent will then receive 1% of his or her total earnings in Euro cash (this will be are a two digit amount of Euro). In addition, every agent will receive 5 Euro in cash.

Procedure
At the beginning of a round you need to decide which amount you want to give to the institution. You need to write this amount in column C on your earnings record sheet and simultaneously on your submission form. Put your submission form face down in front of you and write your ID number on the back of your form.

Thereafter the institution determines whether or not a check will be carried out and who will be checked. The instructor collects the submission forms face down and passes them on to the institution. The institution then carries out the check and notes on the submission form any difference due and any penalty due, if applicable.

The institution then passes all submission forms on to the calculator, who determines the payoff and announces it. Thereafter a new round begins.
Do you have any questions?

Instructions (#2 Block)

All instructions given in the first block remain valid.

The only change is that you can now voluntarily opt for a higher number of random checks. If you do opt for a higher number of random checks then please mark “Alpha” on your earnings record sheet and on your submission form (in addition, also at the back of your submission form).

If you do NOT opt for a higher number of random checks then please mark “Beta” on your earnings record sheet and on your submission form (in addition, also at the back of your submission form).

For both groups „Alpha“ and „Beta“ a coin will now be tossed separately. Again, if the coin shows its face value (number) a check will be carried out in the relevant group, otherwise there will be no check.

For the „**Alpha-Group**“, in case that a check is carried out, *two* cards will be drawn from a properly mixed stack which contains only cards with the numbers of those agents who have jointed the „Alpha-Group“. In case that the „Alpha-Group“ has just one member, this member will be checked.

In addition, the *actually* checked members of the “Alpha-Group” (i.e. one or two) take part in a lottery. In this lottery 72 units of the good are at stake. Again, the lottery winner is drawn from a properly mixed stack of cards which contains only cards with the numbers of “Alpha-Group” members that have been checked (i.e. one or two cards). However, the winner receives the 72 units only if he or she has complied with the rule and has consequently given 20 units to the institution, and no penalty was due. In case that the „Alpha-Group“ has just one member, this member will be checked and, provided that no penalty was due, this member receives the lottery winning.

If the lottery has actually been awarded, the winning (72 units) will be deducted during the calculation of the payoff. That is, it reduces the sum that will be divided by the number of players.

For the „**Beta-Group**”, in case of a check, only *one* card will be drawn from a stack of cards that contains the ID-numbers of all members of the “Beta-Group”. All members of the “Beta-Group” are excluded from the lottery.

The monitoring procedure is otherwise the same as in the first block.

Do you have any questions?

Instructions (#3 Block)

All instructions given in the second block remain valid. The only change now consists of an increase of the penalty. Now the penalty is exactly as high as the difference that is due. The higher penalty applies to both the „Alpha“- and the „Beta“-Group. The monitoring procedure remains the same as before.

Do you have any questions?

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[1] La liste intégrale des Documents de Travail du LAMETA parus depuis 1997 est disponible sur le site internet : http://www.lameta.univ-montp1.fr

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